

NICARAGUA
ARAP
Agriculture Reconstruction Assistance
Program

PRODUCTION OF VEGETABLES USING
SUSTAINABLE ORGANIC METHODS

WITH EMPHASIS ON:

ONIONS
WATERMELONS
CANTALOUPE AND HONEYDEW MELONS
SOFT SQUASH (SUMMER & ZUCCHINI)
HARD SQUASH (BUTTERNUT & ACORN)
FOR EXPORTATION

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Introduction

The problem:

Since the "green revolution" or the world wide adaptation of the use of chemical fertilizers and pesticides to increase agricultural production, farmers around the world have forgotten many of the principles of good husbandry of the land. Chemical fertilizers and pesticides have allowed farmers to escape the consequences of poor agricultural practices for a time. As a result, the health and fertility of many soils around the world has diminished. Soil organic matter has decreased, soil structure has been damaged, erosion has increased and water pollution and sedimentation of rivers, streams and lakes has magnified.

In a soil with good structure, approximately 50% of the soil is composed of the textural constituents of soil, that is sand, silt and/or clay particles. The other 50% is pore space, one-half of the pore space in an ideal situation filled with air and one-half filled with water. When a soil is compacted, there is less pore space making it more difficult for the plant to absorb sufficient water and nutrients and limiting the amount of oxygen available for respiration by plant roots. In other words, the plant is stressed for the essential elements of life: air, water, and nutrients.

Research has demonstrated that insects have the ability to perceive stress in a plant and are attracted to stressed plants over those that grow without stress. Additionally, soilborne plant diseases have the ability to proliferate without the competition from beneficial fungi found in soils with high levels of organic matter. In a healthy soil, diverse populations exist and compete for the elements of life. This competition decreases the activity of plant pathogenic microorganisms.

The use of insecticides not only destroys insect pest populations, but also destroys populations of beneficial insects. The pests that survive then live in an ideal situation where their natural enemies have been drastically reduced or eliminated. Monoculture also has eliminated many of the natural flowering plants that provide the energy required by beneficial insects to proliferate. Beneficial insects obtain protein from the insects consumed, but still require a carbohydrate source. This is provided by the pollen of flowering plants in the vicinity of the field where crops are grown. One research study in California found that aphids could be adequately controlled when 15% of the field was planted to Alyssum as a pollen source for the beneficial insects which consume aphids. No additional pesticide application (either organic or chemical) was required.

In addition to the destruction of soils and increased insect pest and disease problems, pesticide resistance has become a fact of modern agriculture. Additionally, the United Nations Food and Agriculture Organization has documented the presence of poor quality pesticides in developing countries that pose health risks to applicators as well as consumers and may cause damage to flora and fauna and the environment where applied.

Economic

The culture of hybrid varieties and the use of chemical fertilizers and pesticides were implemented in many development projects aimed at improving the economic and living conditions of poor farmers around the world. The combination of hybrid varieties, chemical fertilizers and pesticides did indeed increase agricultural production in many areas. It also increased the amount of risk that poor farmers were exposed to. Since the

majority of farmers needed credit to purchase these inputs, the risk was increased and many lost their assets when crop failure occurred.

At the same time as water pollution, soil erosion and the cost of farm agricultural inputs increased, the profitability of producing agricultural products decreased. In the developed countries of the world, the use of chemical fertilizers and pesticides allowed farm size to grow while the number of farms decreased. Agriculture in the developed world adapted the industrial model using economies of scale to reduce per unit cost (Brumfield, 1996). What the agricultural community was not able to control, however, was the cost of agricultural inputs and the price received for agricultural products. Agriculture has fallen on "hard times" even in the developed world

A Solution

Sustainable Organic Agriculture

Sustainable organic agriculture is based on the principles of good husbandry of the soil. Plant health is dependent upon the health of the soil it grows in. Sustainable organic agriculture encourages healthy soils by maintaining or improving the organic matter content of the soil which in turn improves soil structure and encourages diversity in soil organisms. In effect sustainable organic agriculture seeks to mimic nature and the benefits inherent in a diverse and relatively stable system that has evolved over centuries. With this system insect pest, disease and weed control is dependent upon the health of the soil, that is the organic matter content, structure, nutrient and water supply of the soil, and the tillage practices, crop spacing, field buffers, crop rotation, crop planting schedules, provision of habitat for beneficial insects, use of trap crops, natural diseases of insect pests and other complimentary practices.

Cover Crops, Green Manures and Their Effect on Soil Nitrogen and Erosion

Nitrogen, a major plant nutrient, is not adsorbed by soil particles in its most available (to the plant) form, that is the nitrate nitrogen form. Thus it is readily leached with rain or irrigation from the root zone of growing plants. In light soils it quickly moves into groundwater reserves. Using cover crops or green manures in the interval between cash crops allows the cover crop or green manure plant to take up any available nitrogen and incorporate the element into an organic form that will be available for uptake by succeeding crops once the cover crop or green manure is incorporated into the soil.

A green manure crop is a cover crop that fixes atmospheric nitrogen and is incorporated into the soil to increase soil matter and nitrogen (Abdul-Baki & Teasdale, 1993). Using a green manure crop between cash crops increases soil nitrogen through fixation while recycling available nutrients that could be lost to leaching or erosion. Contributions of organic nitrogen by green manures can be substantial. Studies here in Nicaragua by Ing. Elvenes Vega, of Centro Nacional de Investigaciones, demonstrated that mung bean (*Vigna radiata*) and cowpea (*Vigna unguiculata*) produced 133 and 150 pounds of nitrogen, respectively, per manzana in 50 days. When incorporated in the soil these two legumes decompose rapidly making a good deal of the nitrogen available to the next crop within 15 days of incorporation (personal communication E. Vega, 2001). Other legumes such as terciopelo (*Muncuna pruriens*), canavalia (*Canavalia ensiformis*), and Gandule

(*Cajanus cajanus*) produce more dry matter than mung bean or cowpea, but the nitrogen is fixed within ligninized structures making it more slowly available to the succeeding crop.

Cover crops and green manures decrease soil erosion in several ways. If cover crops or green manures are planted during the rainy season, their presence limits the impact of raindrops on the soil surface. The impact of raindrops results in puddling, decreased water infiltration, increased run off (water erosion of the soil) and destruction of soil aggregates (the major factor in good soil structure). If cover crops or green manures are present during the dry season, their roots hold soil in place reducing erosion by wind.

Living Mulches

A cover crop or green manure crop present in the field at the same time as a cash crop is called a living mulch. Leguminous living mulches when managed properly can reduce weed and insect pressure, soil erosion, and inputs of nitrogen fertilizers. Living mulches must be managed by mowing, light cultivation or flaming in an organic production system or with a combination of the former with the use of herbicides in a conventional system. When the leguminous living mulch is damaged by mowing, cultivation, burning or light herbicide application, nitrogen is released from mulch roots, acting like a sidedress fertilizer application to the cash crop.

Weed Control with Living and Killed Mulches and Other Mulch Materials

Both living and killed mulches help to control weeds by limiting the amount of light that is radiated to the upper few inches of the soil. Most weed seeds have a requirement for some light before germination can take place. This requirement provides an ecological advantage for weed seeds that are buried too deeply in the soil profile to permit emergence before the germinating seed runs out of energy. Additionally, some cover crops show an allelopathic effect on weeds. Rye has been reported to control germination of red root pigweed by chemical substances in the rye plant.

The most critical time for weed control in living mulches is shortly after planting or transplanting the cash crop. The living mulch must be sufficiently suppressed so as to not compete with the cash crop for water, nutrients or light, but it must not be suppressed so early or severely to allow weeds to germinate and become established. An Illinois corn study showed that living mulch suppression two weeks prior to corn planting resulted in poor weed control and reduced yields. In another study on sweet corn in New York, living mulch suppression two weeks after planting produced the highest yields. Knowing the critical weed free growth period for the cash crop is the key to knowing when living mulch suppression is required.

Using killed or living mulches in interrow (aisle) spaces is a viable option for sustainable organic vegetable production. Not only does the mulch suppress weed growth, but living mulches also affect insect pest and nematode populations. Costello and Altieri (1994) found a cabbage and legume living mulch system reduced the number of cabbage aphids (*Brevicoryne brassicae*) compared with a cabbage monoculture. They attributed the difference in aphid populations in the two systems to the lower light intensity reflected off the living mulch.

Using living mulches with a drip irrigation system is a management scheme for reducing competition between the cash crop and the living mulch. Water and nutrients can be delivered directly to the cash crop. Use of living mulch cultivars that are resistant to

nematodes can reduce nematode populations without the use of nematicides (Matthews, et.al., 1998).

In restricted areas such as seedbeds, mulches of rice hulls or sawdust can be used. Generally, four inches of mulch material is required to control weeds. Care must be taken not to incorporate these materials while the crop is in the ground because they have a high carbon to nitrogen ratio. Microorganisms will tie up available nitrogen as they decompose these materials. At the mulch - soil interface, microorganisms may work and limit some nitrogen, however the green manure crop planted before the soil solarization in organic onion production should supply more than enough nitrogen to offset the activity of any microorganisms at the mulch - soil interface.

Use of Living and Killed Mulches for Erosion Control

The promotion and use of killed or living mulches with timely suppression in corn production on sloping soils would greatly reduce soil erosion in rainy season corn production in the tropics. Species which tolerate drought and low fertility, that can be established rapidly for early weed and erosion control, that tolerate field traffic and are low maintenance (few mowing intervals) are the best to use in living mulch production systems. Killed mulches that are not incorporated limit erosion by reducing the impact of raindrops on the soil surface and by the holding power of the killed root systems in the soil. Very small areas can be tilled (for example, 2 inch wide bands) using special planters. This practice which allows at least 30% of the soil surface to be covered with living mulch or crop residues is termed conservation tillage. This practice can also be used for hand planting, tilling a small area around where the seed will be placed.

Post-planting Requirements for Nitrogen

Although cover crops, green manures and living mulches contribute nitrogen to the cash crop, in very few instances is there sufficient nitrogen to satisfy the nitrogen demands of the cash crop. While there have been studies relating soil nitrate levels with nitrogen requirements in field corn, little is known about soil nitrate levels and crop responses in vegetables. Since nitrogen levels are critical for growth and quality in vegetables, constant and adequate levels may be more important than in the case of field crops. Most vegetables have a more restricted root zone than field corn thus adequate nutrition within the area of the root zone is important.

On the Central Coast of California, one study found 20 ppm soil nitrate levels sufficient to delay subsequent sidedressing in lettuce. The "presidedress soil nitrate test"(PSNT) is currently being used in New Jersey (NJ) to predict sidedress nitrogen requirements for field corn, sweet corn, cabbage and pumpkin. Research and experience show that the PSNT works well in soils amended with organic amendments such as compost and manure and in soils where cover crops and green manures are grown. Experience in NJ has shown that soil nitrate levels above 25 ppm are adequate for achieving good yields in field and sweet corn, cabbage and pumpkin. NJ researchers indicate the PSNT should be useful for tomato, pepper, potato, cucumber, lettuce, spinach, carrot, squash and cole crops. Soil samples for PSNT should be taken just prior to the period of rapid nitrogen uptake by the crop. On certain crops such as tomato where there is an extended period of fruiting, several PSNT samples should be taken to monitor nitrogen availability.

PSNT Procedures

Sample soil to a 12-inch depth (about 8 cms.). Collect about 20 subsamples at random from the test area. Areas having different soil types or management histories should be sampled and treated separately.

Crumble the subsamples and thoroughly mix the soil before removing the sample for analysis.

Because microbial activity can rapidly change the concentration of nitrate in soil samples, start to dry samples immediately. Spread soil in a thin layer on a sheet of plastic overnight or dry by placing on cookie sheet in an oven at 200 to 250°F until dry. Or, dry samples in a microwave by spreading a cup of soil on a microwaveable dish and microwave at full power for 5 to 8 minutes. Once dry, crush the soil to fine particle size and remove any stones. Sift the sample through a 10-mesh sieve.

Use one of the commercially available soil nitrate test kits to determine the soil nitrate concentration in parts per million.

Cultural Practices and Selection of Varieties for Disease and Insect Control

Because there are very limited options for disease control in sustainable organic agriculture, growers should select varieties that are adapted for the area of production and that have disease resistance or tolerance. Where known, varieties have been identified in this study that should be tried, preferably in variety trials unless their adaptability is known. All of the varieties could not be located in Nicaragua from distributors here, particularly the Sunseed variety of cantaloupe, Athena, which has excellent disease resistance.

Another very important aspect of disease control in organic production is the use of rotation to minimize the amount of inoculum in the field to cause disease. Research has shown that soils high in organic matter from the use of rotations and green manure crops have less incidence of soilborne diseases and nematodes than soils where rotation and green manures are not used. A good crop rotation in the tropics does not mean onions followed by beans followed by onions, etc., but a rotation that excludes the same crop plant or crop family in the field for a minimum of two years. A longer rotation is better, but not always possible. The use of nematode resistant green manures or cover crops is recommended such as the cowpea variety used in California, *Vigna unguiculata* (L.) Walp. Ssp. *Unguiculata*, or the cover crops used in Florida *Digitaria decumbens*, *Tagetes patula*, *Indigofera hirsute*, *Crotalaria spectabilis*.

Cultural practices that should be implemented include the use of high beds to avoid problems with waterlogging under rainy conditions. Additionally, flowering plants should be planted around the field to encourage beneficial insects. White and yellow flowered plants are the best choices for pollen sources for beneficial insects. Windbreaks should be used to decrease the detrimental effects of winds and to decrease the migration of insects such as thrips into crops from surrounding areas. This is especially important when the rainy season ends and non irrigated areas start to dry. Thrips quickly move with the aid of the wind from these dry areas to irrigated fields. Windbreaks function as a physical barrier slowing the migration of Thrips into the crop.

These windbreaks may also provide shade and habitat for beneficial insects which feed on Thrips and aphids. Several species of small trees which flower in Nicaragua during the dry season may serve as a pollen source for beneficial insects. Generally speaking, however, flowering plants functioning as an energy source (pollen) for beneficial insects

should be about the same height as the crop plant and be very close to or interplanted in the crop field.

Integrated pest management (IPM) is a practice which has been widely adopted by commercial vegetable growers in the U.S.. IPM is based on scouting the crop field and examining a certain number of plants at randomly selected sites in the field. Scouting patterns are usually in an X, W, or Z formation with about 10 sites along the pattern. Five to ten plants are examined at each site for a total of 50 to 100 plants per field. In some cases the scout looks for the presence or absence of the pest. In other cases, the scout counts the actual number of pests on the 50 or 100 plants sampled.

Control decisions are made on an economic basis. When the cost of damage caused by a pest exceeds the cost of a control measure, control is implemented. In general, IPM programs save one to three control applications over what is applied on a calendar basis (every 7 to 10 days, for example). Often control measures are more efficacious because of better timing.

For example, Upon scouting an onion field, a scout encounters several *Spodoptera* egg masses on onion leaves as the field is scouted. If the egg masses are white in color, the grower should wait three days to implement controls because the eggs are not ready to hatch. If the egg masses are cream in color, controls should be implemented the following day because hatching is imminent. Biological controls such as *Bacillus thuringiensis* (Bt) (a bacteria which causes disease in *Spodoptera* larvae) and VPN (a virus which causes disease in *Spodoptera* larvae) have a short residual life and are more efficacious on small (first and second instar) larvae than on larger larvae. Bt will not control *Spodoptera* larvae once they have passed the third instar.

Another strategy for monitoring the presence of pests is the use of pheromone traps. Essentially species specific, these pheromones help males find receptive females for mating. Used in a trap, pheromones attracting males let farmers know when *Spodoptera* are entering a field. Large numbers indicate a heavy influx. Used in conjunction with scouting, pheromone traps allow growers to know when controls should be implemented. Waiting until holes are evident in onion leaves or larvae are crawling over developing melons will assure a high cull rate in the packing shed.

Sample scouting guides are included with this report. These guides were developed for the Mid-Atlantic Region of the United States and cannot be guaranteed to be valid for Nicaragua. Pests, diseases and crop dynamics are different in different regions so scouting guides must be fine tuned and validated for each area.

Managing Nutrient Levels in Sustainable Organic Production

Just as a conventional grower uses soil test information to plan a fertility program for a crop so does an organic grower use this information. The difference between the two systems is that the organic farmer satisfies the crop's nutritional requirements by building up the fertility of the soil through the use of green manures and the addition of organic amendments such as compost, ash, poultry or other animal manure, seafood waste, blood or bone meal.

As much as possible nutrients should be kept in balance, but the most important nutrient to manage is nitrogen. Either a deficiency or an excess can have detrimental results. Besides the obvious effects on yield and quality, an imbalance can make the crop more prone to disease resulting in absolute crop loss if severe.

The following information on green manure costs of production provides information on research conducted on various green manure crops produced in Nicaragua, the amount of fresh and dried material and the nitrogen content of the dry matter produced. Green manure crops also contribute phosphorus and potassium as well as micronutrients to the cash crop as they decompose. These nutrients were taken up by the green manure crop as it was growing and are essentially recycled upon decomposition. Unfortunately no information is available on the amount of phosphorus and potassium in the dry material produced by the green manure crop.

Green Manure Costs of Production

Preplant

Seed Costs:

Green manure crop:

Mung Bean (*Vigna radiata*) 60 pounds/manzana = 300 córdobas

Cowpea (*Vigna sinensis*) 40 pounds/manzana = 200 córdobas

Terciopelo (*Muncuna pruriens*) 40 pounds/manzana = 200 córdobas

Gandule (*Cajanus cajanus*) 40 pounds/manzana = 200 córdobas

Canavalia (*Canavalia ensiformis*) 40 pounds/manzana = 200 córdobas

Soil Preparation:

Disking	105.00 córdobas	\$7.90
Labor to plant green manure crop	30.00 córdobas	\$2.30
Incorporation of green manure by disking	105.00 córdobas	\$/90

Nitrogen fixed by various green manures in Nicaragua:

Mung Bean	5.4 T/ha dry matter	133 lbs N/mz
Cowpea	2.8 T/ha dry matter	151 lbs N/mz
Terciopelo		2.5% in dry matter
Canavalia	8.0 T/ha dry matter	111 lbs. N/mz
Gandul*	4.9 T/ha dry matter	257 lbs. N/mz

*Produced more dry matter in Estelí, but nitrogen content was not determined.

Total Cost of Nitrogen Produced by Various Green Manure Crops

Mung Bean	4.06 córdobas/libra N/manzana
Cowpea	2.91 córdobas/libra N/manzana
Terciopelo	
Canavalia	3.96 córdobas/libra N/manzana
Gandul	2.76 córdobas/libra N/manzana*

While Gandul appears to be the least costly for each pound of nitrogen produced, it is photoperiodic, is slow to become established and requires additional labor for weed control (reflected in the cost of the nitrogen) and its nitrogen is slowly released because it is incorporated in ligninized structures. Cowpea requires only 50 days to produce 151 lbs of nitrogen, does not require weeding, is not photoperiodic and its nitrogen is available within

15 days after incorporation. One cultivar of cowpea used in California is resistant to nematodes and has been demonstrated to reduce nematode populations in the soil. For this study, the cost of nitrogen supplied by a green manure crop will be based on the use of cowpea except where noted otherwise.

All calculations based on: Tasa de cambio 0 13.2 córdobas/\$1.00 U.S.

Producción de Cebolla Orgánica
Costo d Producción por Manzana

Soil Solarization is best carried out during the dry season during the months of March and April when the sun is hottest. However there is a period of sunny weather, a “canicula” during late June, July and early August when soil solarization could be carried out. The area to be solarized should remain humid and covered with clear plastic for 8 weeks. At the end of the solarization period, if the farmer is not ready to plant the seedbed, allow it to remain covered until ready to plant. The clear plastic can be reused as long as it does not become cloudy in appearance. Not only is this a good practice for onions as in the example in this study, but it is very appropriate for use in any seedbed situation (tomatoes, peppers, cabbage, etc.)

Fifty days before preparing the soil for solarization, a green manure crop should be planted. Since the nitrogen fixed by the legume should be slowly available, Canavalia is a better choice. The nitrogen in Canavalia is fixed in ligninized structures and requires more time to decompose (nitrification).

<u>Semillero para una manzana de cebollas 350 M = .05 manzana)</u>		Córdobas
Dolares		
Soil Solarization 15 junio hasta 15 de agosto		
Preparación de suelo (Incorporación de abono verde con chapoda (1), arado y grada (2)		51.50
3.90		
Forjado de bancos		35.50
2.70		
Riego y aplicación de plástico transparente (2 personas)		60.00
2.30		
Plástico transparente 1.25 rollos @ \$11.95/rollo		200.00
15.05		
Riegos semanalmente (7) para mantener la humedad del suelo		210.00
15.91		
Siembra de Semillero		
Uncover the beds and apply and incorporate organic fertilizer and Torta de Nim (control de insectos del suelo) (3 personas)		90.00
6.82		
4.5 qq Pollinaza de Patio (M#3)		90.00
6.82		
17 qq de ash de café o arroz (costo de transporte)		340.00
25.76		
Torta de Nim		18.75 –
25 1.42 - 1.89		
Siembra de semilla de cebolla (2.5 personas)		75.00
5.70		
3 libras de semilla de Equanex		2577.00
225.00		
O		O
O		

3 libras de semilla de Yellow Granex PRR	2100.00
159.00	
Installation of covers to prevent rain damage (6 people)	180.00
13.64	
Producción de Cebolla Orgánica	
Manejo de techo	104.00
7.87	
Materials for covers: hierro ¼"	325.00
24.61	
Tela	805.00
60.94	
Cabulla macen	38.00
2.83	
Aplicación de casulla de arroz (mulch to control weeds)	20.00
9.09	
2.5 cms minimo cada semana por 4 semanas después de la germinación de cebolla, costo de transporte	889.00
67.35	
Deshierba	60.00
4.55	
Riegos	468.00
35.43	
Aplicación de fertilizante foliar (Nutriente Verde)	6.00
.48	
Costo Total de Semillero para una manzana de cebolla	
Cultivo de Cebolla	
Preparación de campo	
Chapoda	104.00
7.87	
Arado	311.78
23.62	
Grada	125.00
9.45	
Aplicación de fertilizante orgánica, torta de nim (3 personas)	120.00
9.09	
Torta de Nim 15 – 20 qq/Mz	375 – 500
28.41 - 37.88	
Fertilizante Orgánica	
Costo de abono verde incorporado – caupi (151 lbs. N/mz)	440.00
30.30	
Compost de Pollo (39 qq)	
Ash de arroz o café (9 qq)	
Grada (2)	250.00
18.90	

Nivelación	415.80
31.50	
Encamado	104.00
7.87	
Trasplante (25 personas/Mz)	750.00
56.82	
Aplicaciones de fertilizante foliares Mano de obra (1.5 personas)	45.00
3.41	
8 días después el trasplante 500 cc/mz Crop Up	88.31
6.69	
20 días después trasplante 500 cc/mz Crop up	88.31
6.69	
Producción de Cebolla Orgánica	
250 cc/mz Metalosato de zinc	44.22
3.35	
750 cc/mz N-P-K Foliar	95.44
7.23	
50 días después trasplante 500 cc Metalosato de Calcio	88.31
6.69	
1 litro Metalosato de Potasio	127.25
9.64	
Monitoreo de cultivo por programa MIP	960.00
72.73	
Spodoptera pheromone for monitoring purposes	59.40
4.50	
Mano de obra para aplicar insecticidas y fungicidas (22 personas)	660.00
50.00	
Insecticidas	
3 aplicaciones de VPN (control de Spodoptera)	500.40
36.00	
5 aplicaciones de jabón más aceite vegetal (control de Thrips)	60.55
4.59	
5 aplicaciones de Nim más baking soda (control de Thrips)	112.50
8.52	
Funguicidas	
8 – 9 aplicaciones de Phytón 24S para control de Alternaria	1346.40 –
1514.70 102.00 – 114.75	
Deshierbas (24 personas)	720.00
54.55	
Riego (20 personas)	600.00
45.45	
Energia electrica	1794.01
135.91	
O Combustible y Lubricante para regar	

Cosecha

Arranque (8 personas)	240.00
18.18	
Destalle-desralzado (19 personas)	570.00
43.18	
Ensacado (15 personas)	450.00
34.09	
Volteo de sacos (4 personas)	120.00
9.09	
Acarreo a planta (6 personas)	180.00
13.64	
Transporte a planta (400 qq x .50 córdobas)	200.00
15.15	

Producción Orgánica de Melon Cantaloup
Costos de Producción por Manzana

<u>Actividad</u>	Costo en	Costo en <u>Córdobas</u> <u>Dolares</u> <u>U.S.</u>
Preparation, fertilization and Seeding		
Arado	23.62	312.00
Grada (1 pase)	9.47	125.00
Aplicación de fertilizante orgánica y Torta de Nim (3 personas)	6.82	90.00
Costo de abono verde – caupi (151 lbs. N/mz)	30.30	440.00
	375 – 500	Torta de Nim 15 – 20 qq/Mz 28.41 - 37.88
Compost de Pollo 27 qq		
Ash 67 qq/mz (Costo de transporte)	10.15-14.02	134-185
Grada (2)	18.94	250.00
Nivelación	31.50	415.80
Surqueo	7.90	105.00
Encamado	7.90	105.00
Aplicación de plástico negro	95.13	1255.76
Plástico negro	141.84	1872.30
Siembra		
*Semilla (varies by variety) 2lbs/mz	28.00-467.54	369.60-6171.53
Transporte de insumos	8.00	105.60
Raleo (2 personas)	4.55	60.00
Arreglo de guías-podas (2 personas)	4.55	60.00
Volteo de frutas (4 personas)	9.10	120.00

Deshierbas (5 personas)	150.00
11.36	
First cultivation with cultivator (type – Lilliston)	141.90
10.75	
Aplicación de fertilizante foliar (1.5 personas)	45.00
3.41	
5 semanas después la siembra	99.92
7.57	
1 semana después	99.92
7.57	
1 semana después	99.92
7.57	
Producción Orgánica de Melon Cantaloup	
Control de insectos y enfermedades	
Monitoreo por programa MIP 9 semanas @40 córdobas/monitoreo	
360.00 27.27	
Pheromone to detect presence of Spodoptera (2)	
39.60 3.00	
VPN para el control de Spodoptera (2 – 3 aplicaciones)	
316.80-475.20 24-36.00	
(Javelin)Bacillus thuringiensis para el control de <i>Diaphania hyalinata</i>	
(8 aplicaciones de dosis 250 – 300 cc/mz)	
739.20-887.04 56-67.20	
Nim más baking soda (3 aplicaciones para el control de áfidos y mosca blanca)	
67.50 5.11	
Jabón más aceite vegetal (3 aplicaciones para el control de áfidos y mosca blanca)	
36.33 2.75	
Phyton 24S para el control de mildew (5-6 aplicaciones)	
841.50 -1009.80 63.75-76.50	
Riego (20 personas) (menos si usa riego por goteo)	
600.00 45.45	
Energia electrica	
1213.34 91.92	
Polinación	
Alquila de apiarios (3/mz)	594.00
45.00	
Manejo y traslado de apiarios	
70.00 5.30	
Cosecha	
Corte de la fruta (28 personas)	
840.00 63.64	
Cargado de la fruta (8 personas)	
240.00 18.18	
Acarreo a la planta	
792.00 59.60	

	Remove black plastic (5 persons)	
150.00		11.36
Selección y empaque		
	Mano de obra (24 personas)	
720.00		54.55
	550 cajas (parafinadas si está permitida para productos orgánicos)	
10527.00		797.50
	Refrigeración	
4355.10		329.93
	Cargado de contenedor (4 personas)	
120.00		9.09
	Registro de temperatura	
954.00		70.00
	Transporte (18 pallets of 64 boxes/pallet)	
Administración (13% de todo de costo de producción)		

Producción Orgánica de Melon Honeydew
Costos de Producción por Manzana

<u>Actividad</u>	Costo en	Costo en
		<u>Córdobas</u>
		<u>Dolares</u>
		<u>U.S.</u>
Preparation, fertilization and Seeding		
Arado		312.00
	23.62	
Grada (1 pase)		125.00
	9.47	
Aplicación de fertilizante orgánica y Torta de Nim (3 personas)		90.00
	6.82	
Costo de abono verde – caupi (151 lbs. N/mz)		440.00
	30.30	
	375 – 500	
	Torta de Nim 15 – 20 qq/Mz	
	28.41 - 37.88	
Compost de Pollo 27 qq		
67 qq ceniza de arroz o cafe (Costo de transporte)		134-185
	10.15-14.02	
Grada (2)		250.00
	18.94	
Nivelación		415.80
	31.50	
Surqueo		105.00
	7.90	
Encamado		105.00
	7.90	
Aplicación de plástico negro cinta por riego por goteo		1255.76
	95.13	
Plástico negro		1872.30
	141.84	
Siembra		
*Semilla (varies by variety) 2lbs/mz		369.60-6171.53
	28.00-467.54	
Transporte de insumos		105.60
	8.00	
Raleo (2 personas)		60.00
	4.55	
Arreglo de guias-podas (2 personas)		60.00
	4.55	
Volteo de frutas (4 personas)		120.00
	9.10	

Deshierbas (5 personas)	150.00
11.36	
First cultivation with cultivator (type – Lilliston)	141.90
10.75	
Aplicación de fertilizante foliar (1.5 personas)	45.00
3.41	
5 semanas después la siembra	99.92
7.57	
1 semana después	99.92
7.57	
1 semana después	99.92
7.57	
Producción Orgánica de Melon Honeydew	
Control de insectos y enfermedades	
Monitoreo por programa MIP 9 semanas @40 córdobas/monitoreo	
360.00	27.27
Pheromone to detect presence of Spodoptera (2)	
39.60	3.00
VPN para el control de Spodoptera	
316.80-475.20	24-36.00
(Javelin)Bacillus thuringiensis para el control de Diaphania (8 aplicaciones)	
739.20-887.04	56-67.20
Nim más baking soda (3 aplicaciones para el control de áfidos y mosca blanca)	
67.50	5.11
Jabón más aceite vegetal (3 aplicaciones para el control de áfidos y mosca blanca)	
36.33	2.75
Phyton 24S para el control de mildew (5-6 aplicaciones)	
841.50 -1009.80	63.75-76.50
Sistema de Riego por goteo con la cinta	
13699.22	1037.82
(2 personas)	
60.00	4.55
Energia electrica	
1213.34	91.92
Polinación 3 colmenas/mz	
Alquila de apiarios	
594.00	45.00
Manejo y traslado de apiarios	
70.00	5.30
Cosecha	
Corte de la fruta (15 personas)	
450.00	34.09
Cargado de la fruta (8 personas)	
240.00	18.18
Acarreo a la planta	
791.98	59.60

Selección y empaque

Mano de obra (24 personas)	
720.00	54.55
800 cajas (parafinadas si está permitida por productos orgánicos)	
15312.00	1160.00
Refrigeración	
4219.23	319.64
Cargado de contenedor (4 personas)	
120.00	9.09
Registro de temperatura	
954.00	70.00

Administración (13% de costo de producción)

Producción Orgánica de Sandía
Costos de Producción por Manzana

<u>Actividad</u>	<u>Costo en</u>	<u>Costo en</u>	<u>Có</u> <u>rdobas</u>	<u>Do</u> <u>lars U.S.</u>
Arado	312.00	23.62		
Grada (1 pase)	125.00	9.47		
Aplicación de fertilizante orgánica (4 personas)	120.00	9.09		
Costo de abono verde incorporado – caupi (151 lbs. N/mz)	440.00	30.30		
30 qq ceniza de arroz o café (costo de transporte)	500.00	37.88		
Torta de Nim 15 – 20 qq/Mz	375 – 500	28.41 - 37.88		
Grada (2)	250.00	18.94		
Surqueo	105.00	7.90		
Encamado	105.00	7.90		
Raya de Siembra (1 pase)	125.00	9.47		
Hoyado (4 personas)	120.00	9.09		
Siembra (2 personas)	60.00	4.55		
Semilla – Charleston Gray 2 libras	354.00	26.80		
O				
O				
Semilla – Jubilee 2 libras	424.00	32.00		
O				
O				
Semilla – Micky Lee 2 libras	820.00	62.00		

Note: The following are varieties with resistance to Anthracnose and Fusarium Wilt that are recommended for planting in trials first to determine their adaptability to Nicaraguan

conditions: Crimson Sweet, Stars & Stripes, Mardi Gras, Star Brite, Mirage, and Millenium.

Cultivate Fields (2X)

396.00	30.00
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Deshierba (2X) (8 personas)

480.00	36.36
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Aporque (2X) (4 personas)

120.00	9.09
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Aplicación de insecticidas, fungicidas, y fertilizantes

foliares 5-10X (2 personas)

300.00-600.00	22.73-45.45
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Monitoreo por programa MIP 9 semanas @40 córdobas/monitoreo

360.00	27.27
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Producción de Sandía Orgánica

Pheromone to detect presence of Spodoptera (2)

39.60	3.00
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VPN para el control de Spodoptera

316.80-475.20	24-36.00
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(Javelin)Bacillus thuringiensis para el control de *Diaphania hyalinata*
(8 aplicaciones)

739.20-887.04	56-67.20
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Nim más baking soda (3 aplicaciones para el control de áfidos y mosca blanca)

67.50	5.11
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Jabón más aceite vegetal (3 aplicaciones para el control de áfidos y mosca blanca)

36.33	2.75
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Phyton 24S para el control de mildew (5-6 aplicaciones)

841.50 -1009.80	63.75-76.50
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Poda y Despunte (2 personas)

60.00	4.55
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Volteo de frutas (3 personas) (dos veces)

90.00	6.82
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Riego por surco

Manejo (54 personas)

1620.00	122.73
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Combustible 54 gal. Diesel @ 23.75 córdobas/gal

1282.50	97.16
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Lubricantes 8 litros @ 27 córdobas/litro

216.00	16.36
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Polinación

Alquila de apiarios

594.00	45.00
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Manejo y traslado de apiarios

70.00	5.30
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Manejo y traslado de apiarios

70.00	5.30
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Cosecha

CHEMONICS INTERNATIONAL, INC

Corte y acarreo (20 personas)

600.00 45.45

Rendimiento en Nicaragua per APENN is 2400 sandia equals¿ cajas?

Packing information not available.

Producción Orgánica de Pipian, Tipo Zucchini y “Summer Squash”
Costos de Producción por Manzana

<u>Actividad</u>	Costo en	Costo en
		<u>Córdobas</u>
		<u>Dolars</u>
		<u>U.S.</u>
Arado	23.62	312.00
Grada (1 pase)	9.47	125.00
Aplicación de fertilizante orgánica (3 personas)	6.82	90.00
Costo de abono verde – caupi (151 lbs. N/mz)	30.30	440.00
19 qq Compost de Pollo (M#2)		
63 qq de Ceniza de arroz o café (costo de transporte)	56.82	750.00
Torta de Nim 15 – 20 qq/Mz	28.41 - 37.88	375 – 500
Grada (2)	18.94	250.00
Surqueo	7.90	105.00
Encamado	7.90	105.00
Lay reflective plastic mulch	55.00	726.00
Reflective mulch (cost not known at present)		
Hoyado (2 personas)	4.55	60.00
Siembra		
Zucchini Semilla Grey Zucchini	25.00	330.00
Revenue*		
Dividend*		
Summer Squash		
Liberator*		
Deshierba (8 personas) Interrow spaces	18.18	240.00
O		O
O		
Cultivate Fields (2X)	30.00	396.00
Mano de obra -aplicación de insecticida, fungicida, fertilizante		

Foliar (20 personas)	600.00
45.45	
* Resistant to Cucumber Mosaic Virus, Zucchini Yellow Mosaic Virus and Watermelon Mosaic Virus. Cost of these varieties in Nicaragua is unknown.	
Producción Orgánica de Pipian, Tipo Zucchini y “Summer Squash”	
Riego (16 personas)	480.00
36.36	
Combustible (diesel 4 gal. @23.75 córdobas/gal)	95.00
7.20	
Lubricantes (3 litros @27 córdobas/litro)	81.00
6.14	
Polinación	
Alquila de apiarios	
594.00	45.00
Manejo y traslado de apiarios	
70.00	5.30
Cosecha	
Corte Y acarreo (108 personas)	3240.00
245.45	

Producción Orgánica de Zapallo, Tipo Acorn y Butternut
Costos de Producción por Manzana

<u>Actividad</u>	Costo en	Costo en <u>Córdobas</u> <u>Dolars</u> <u>U.S.</u>
Arado	23.62	312.00
Grada (1 pase)	9.47	125.00
Aplicación de fertilizante orgánica (3 personas)	6.82	90.00
Costo de abono verde – caupi (151 lbs. N/mz)	30.30	440.00
Gallinaza		
Ash		
Torta de Nim 15 – 20 qq/Mz	28.41 - 37.88	375 – 500
Boro*		
Grada (2)	18.94	250.00
Surqueo	7.90	105.00
Encamado		
Hoyado (2 personas)	7.90	105.00
Siembra		
Semilla		
Aporque (8 personas)	18.18	240.00
Deshierba (16 personas)	36.36	480.00
Cultivate Fields (2X)	30.00	396.00
Aplicación de insecticida, fungicida, fertilizante		
Foliar (20 personas)	45.45	600.00

- Based on soil tests. If soil test report shows 0.0 – 0.35 ppm B, apply 3.5 libras de boro por manzanas.
- If soil test report shows 0.36 – 0.70 ppm B, apply 1.7 libras de boro por manzanas.

Producción Orgánica de Zapallo, Tipo Acorn y Butternut

Riego (16 personas)	
480.00	36.36
Combustible (diesel 4 gal. @23.75 córdobas/gal)	
95.00	7.20
Lubricantes (3 litros @27 córdobas/litro)	
81.00	6.14

Polinación

Alquila de apiarios	
594.00	45.00
Manejo y traslado de apiarios	
70.00	5.30

Cosecha

Acorn takes about 50 days , butternut about 80 days.

Packing Costs not know at this point

Markets, Shipping and Price Information

Imports into the U.S. of Watermelon, Honeydew and Cantaloupe Melons, Hard and Soft Squash:

Watermelon: December – May

Honeydew and Cantaloupe Melons: January – April

Squash: November – April

Onions: November – March

SHIPPING INFORMATION

Hard Squash (Winter Squash) – Butternut and Acorn

Ship at 10 – 13°C (50 – 55° F), Relative Humidity 70%

Subject to chilling injury at temperatures below 10°C.

Sensitive to ethylene.

Soft Squash – Summer Squash and Zucchini Squash

Ship at 5 – 10°C (41 – 50°F), Relative Humidity 95%

Subject to chilling injury at temperatures below 5°C.

Sensitive to ethylene

Honeydew Melon

Shipping sizes: 4,5,6,8,9,10 and 12 melons/box

Ship at 7 – 10°C (45 – 50 °F), Relative Humidity 90%

Subject to chilling injury at temperatures below 7°C

Ethylene producer

Cantaloupe Melon

Shipping sizes: 9, 12, 15, 18 and 23 count/box or crate

Should be precooled with forced air cooling or hydrocooling.

Ship at 2 – 5°C (36 – 41°F), 38°F preferred shipping temperature, Relative Humidity 95%

Sensitive to ethylene.

Watermelon

Shipping Sizes:

Picnic = 15 – 45 pounds

Ice Box = 5 – 15 pounds

Seedless = 10 – 25 pounds

Yellow = 10 – 30 pounds

Ship at 10 – 15°C (50 – 60°F), Relative Humidity 90%

Subject to chilling injury at temperatures below 10°C

Sensitive to ethylene.

Further Information Required

Investigate the cost and chemical composition of shrimp and crab wastes for use as a fertilizer, especially to meet the phosphorus and potassium requirements of plants for fields

far removed from rice or coffee milling facilities where the cost of transportation of ash may be high.